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ORIGINAL ARTICLE

Pectin-encrusted gold nanocomposites containing phytic acid and jacalin: 1,2-dimethylhydrazine-induced colon carcinogenesis in Wistar rats, PI3K/Akt, COX-2, and serum metabolomics as potential targets

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Abstract
Phytic acid (PA) has momentous chemotherapeutic potential. Due to the chelate formation and rapid elimination, it is not popular in cancer treatment. The present work was inquested to develop a surface-modified nanoformulation of PA which prevents its speedy elimination and maximizes chemotherapeutic action. Chloroauric acid was reduced with pectin to produce pectin-gold nanoparticles (PGNPs). PGNPs were incubated with PA and jacalin for drug loading and surface modifications, respectively, to form PA-loaded jacalin-pectin-gold nanoparticles (PA-J-PGNPs). Formulation(s) were assessed for various pharmaceutical/pharmacological parameters. To validate the efficacy against colon carcinogenesis, formulation(s) were assessed in 1,2-dimethylhydrazine (DMH)-treated Wistar rats. DMH treatment distorted colonic architecture, oxidative, and hemodynamic parameters, which were favorably restored by PA-J-PGNP administration. To further confirm our deliberations, formulation(s) were also examined against DMH-altered metabolic changes and expression of markers pertaining to cellular proliferation, which was reinstated by PA-J-PGNPs. Our findings establish PA formulation(s) as a promising approach for suppression of colon carcinogenesis.

Keywords IP6 · Surface modification · ^{1}H NMR spectroscopy · Hemodynamic changes · Western blotting · RT-PCR

Introduction

Colon cancer is escalating its threat due to high mortality rate. It is made known as the third most common cancer found in men and women, worldwide. Presently, it constitutes approximately 10% of the cancer burden. Colorectal cancer is likely to expand by 60% and >2.2 million new cases have been predicted by 2030 [1].

To facilitate cancer prevention, efforts are being made amongst which, the use of naturally occurring constituents as chemopreventive and chemotherapeutic agents has seen a rise, due to their safety, availability, and general acceptance [2]. Phytic acid (PA) is one such naturally occurring carbohydrate, generally found in legumes, nuts, fruit, etc. Various researches proved that intake of PA containing legumes is linked with the lessening of incidences of colon cancers [3, 4]. However, this bioactive carbohydrate is largely underutilized due to its shortcoming of fast chelation and elimination from the body, within an hour of oral administration [5].

To eliminate its limitation and to maximize the chemotherapeutic activity, a surface-modified nanoformulation of PA may be developed. Gold nanoparticles have drawn attention due to their distinctive properties which make them valuable for application as controlled drug delivery agents, contrast agents, and biosensors for cancer detection and treatment [6–8]. Active targeting of a nanoparticulate system may be accomplished through surface functionalization of the nanoparticles with antibodies, proteins, peptides, and aptamers.

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